FSK Demodulation Using the SX Microcontroller

Application Note 8

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1.0 Introduction

This document describes the use of Scenix SX microcontroller to perform FSK (or frequency-shift keying) demodulation. In the past, telephony functions such as FSK (frequency-shift keying) generation and detection, DTMF (dual-tone, multi-frequency) generation and detection, and Caller ID could not be implemented with an 8-bit embedded MCU because performance levels were not high enough to support them. As a result, either a custom MCU had to be designed or a 16- or 32-bit device be used. Now, the Scenix Semiconductor SX Series MCUs with performance reaching 100 MIPS (million instructions per second) and a deterministic interrupt architecture, overcome the challenge by providing the ability to perform these functions in software.

Unlike other MCUs that add functions in the form of additional silicon, the SX Series uses its industry-leading performance to execute functions as software modules (Virtual Peripheral™ modules) that reside in the high-speed (10 ns access time) on-chip flash/EEPROM program memory and executed as required. In addition, a set of on-chip hardware peripherals is available to perform operations that cannot readily be done in software, such as comparators, timers, and oscillators.

FSK is a modem communications protocol used to take advantage of analog line (Plain Old Telephone Lines - POTS). With frequency shift keying, the transmitting modem converts a bitstream (1's or 0's) into a varying frequency which can be easily transmitted over telephone lines. The receiving modem receives this modulated signal and transforms it back into a bitstream. The solution presented in this document a very simple zero-cross method for FSK receive. The simplicity of the algorithm results in a program size of only 67 words. In addition, the algorithm requires only 2 bytes of RAM and one I/O pin to receive an FSK modulated signal. The FSK specification described in this document uses 1300Hz to represent a '1' and 2100Hz to represent a '0'. The maximum data rate for this type of modulation is 1200 baud.

Although not nearly as common as the newer PSK (Phase Shift Keying) techniques of modulation, FSK is a simple, inexpensive, and easy way to achieve low-speed communications. Some applications of low-speed FSK are remote sensing equipment, automatic teller machines, and Caller ID devices.

2.0 Software Implementation

The software implementation of FSK detection is very simple. The transitions on the input pin are timed by the software. If the transitions happen within a specified time, then a high frequency is being detected, otherwise a low frequency is being detected. The program sets the RS-232 TX pin high or low, depending on the frequency being detected.

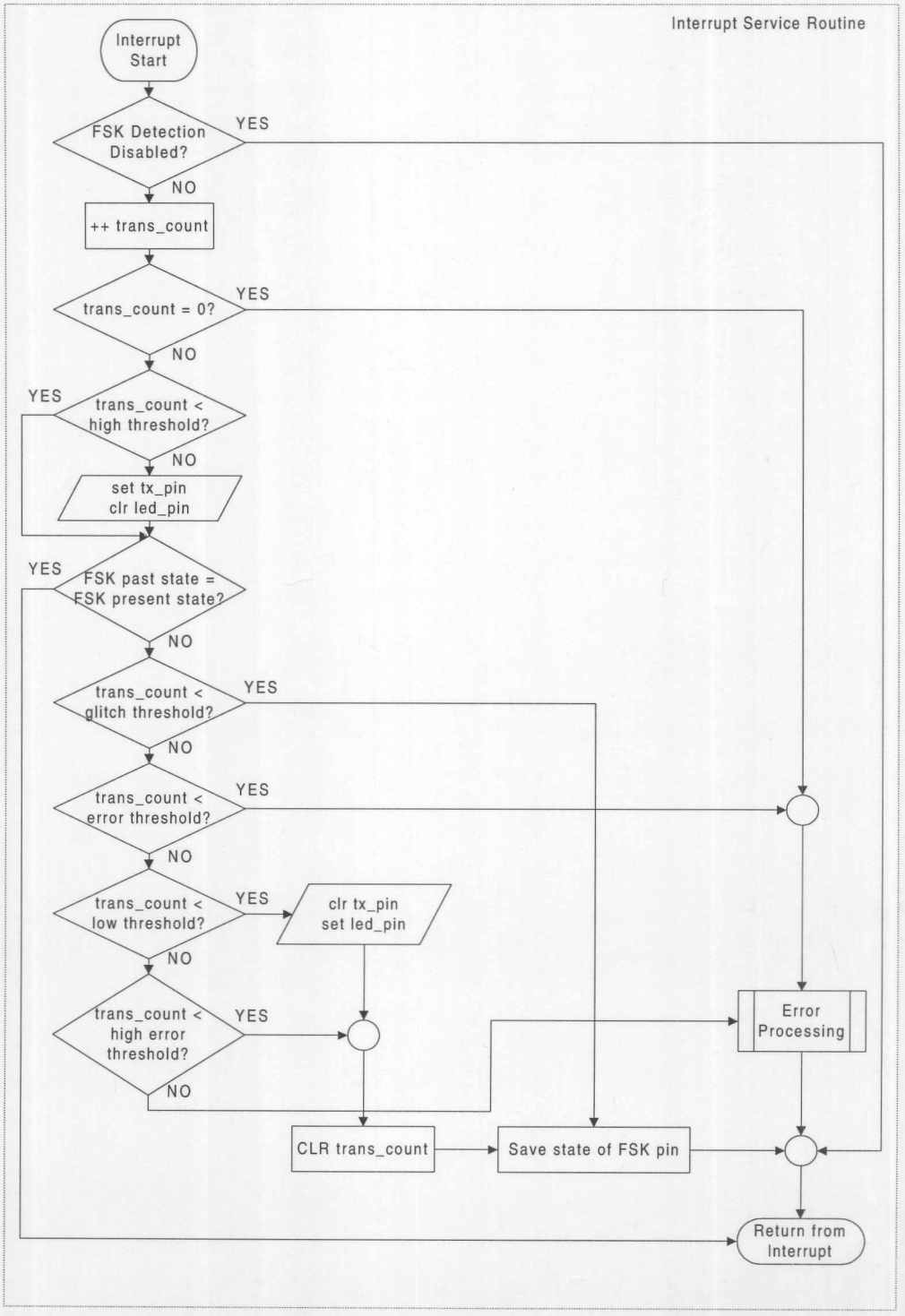

Figure 2-1. Interrupt Service Routine Flowchart

3.0 Circuit Design

Figure 3.1 shows the necessary hardware for FSK demodulation.

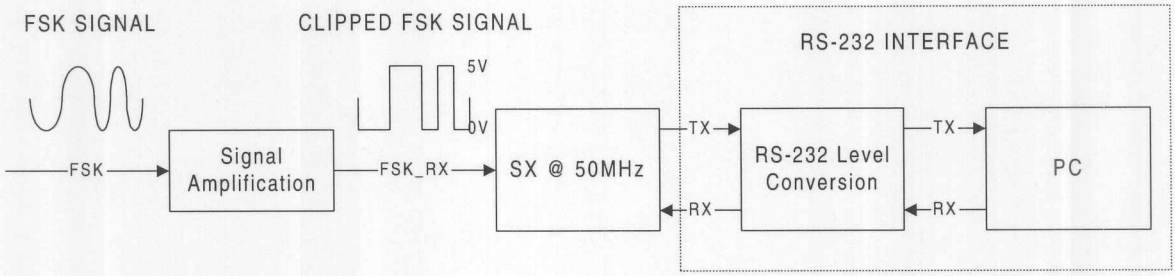

Figure 3-1. Hardware for FSK Demodulation

Demonstrating FSK detection requires this type of circuit, in addition to some means of creating the FSK signal. Integrating this type of solution into an operational modem would require one additional block: the isolation circuitry, which isolates the outside phone line from the modem's internal analog circuitry (there are standard isolation circuits for every country).

The input signal into the SX must be clipped because the FSK detection program uses a Schmitt Trigger input. This allows the SX to reject a larger amount of noise.

4.0 Operation

Upon power up, the program initializes the necessary registers and proceeds to loop until the RS-232 RX pin is pulled low, which will happen when a character is typed on the local PC. When this occurs, the program enables interrupts. Once interrupts are enabled, the FSK detection begins running. The main program begins with a wait loop, while the interrupt service routine converts the incoming FSK signal into a '1' or '0' on the RS-232 TX pin. When a signal from a transmitting modem at 1200 baud or lower is provided, this algorithm will demodulate the signal back into a bitstream, which can be received by the UART of a local PC. The demodulated baud rate will match the baud rate of the transmitting modem. For a means of generating an FSK signal, see the documentation on generating FSK (Appnote # 9)

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